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APPLE III REVIEWED

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P.S.

The latest rumours about Hitachi are incorrect. Contrary to the opinions in the APC art room, no left hand versions of the Peach are being manufactured. For once my source is both authoritative and emphatic (!)

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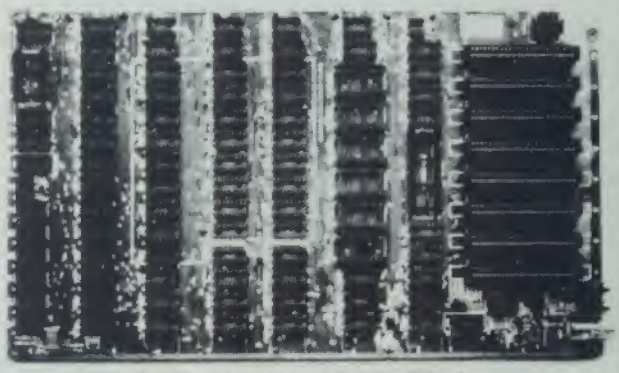

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APPLE III

REVIEWED

by Ian Webster.

The Apple III first appeared as an ever changing set of rumours in 1979, when people realised that Apple's considerable development effort was about to produce a new machine. The machine was released at NCC 81 and quickly gained a reputation for being bug-ridden. Consequently, the machine was put on hold while the problems were fixed. Most of them were associated with chips coming loose from the sockets in the motherboard and clock chip stability.

The release of Pascal III and the Profile hard disk system provided Apple with an opportunity to relaunch the III and to express their satisfaction with the product.

Steve Jobs has said that Apple intends to build a range of machines exploring the dimensions of the personal computer, and this has been the basis of Apple's design philosophy. These machines are based on large RAM based computers supported by sophisticated operating environments. This evaluation was written during a Festival of Sydney workshop. People with experience in video, audio and photography were being introduced to computers as a creative medium. The experience of the workshop really confirmed the importance of Steve Jobs observations.

THE STANDARD MACHINE

The Apple III is a 6502B based machine with 128k of RAM memory. There is a built-in 5.25 inch floppy disk drive. The machine has an RS232B port, two joystick interfaces, video and audio ports, a Silenttype printer interface and four expansion slots. The system is packaged with a separate monitor: either colour or green screen. The SOS operating system, Business Basic and Visicalc are supplied with the machine. The expansion options are to daisy chain up to three floppy disk drives from the built in drive, the Profile hard disk and Apple Pascal III.

HARDWARE

The Apple III has a cast aluminium case with an extended keyboard. The motherboard is under the case. There is a moulded plastic cover over the built-in disk drive, the power supply and a space for four expansion boards. The computer is fairly heavy and sits firmly on the table.

The keyboard extends from the front of the computer, and could easily have been detachable. The keyboard has 61 keys and a 13 key keypad. All 128 ASCII characters can be generated and all keys have auto-repeat. (The four cursor keys have two speed auto-repeat.) The keyboard is an improvement on the Apple II keyboard, but the keys still feel a little insecure.

A 5¼ inch (140k) floppy disk drive is built into the lefthand side of the case. The disk controller is on the motherboard and can accommodate three daisy chained drives.

A 2 inch speaker driven by a six bit DAC is mounted in the center of the case.

The motherboard is a 15 inch x 10 inch board that is only accessible from the bottom of the case. The board contains all chips except for the RAM which is contained on a piggyback card that has 32 16k bit RAMs and 16 32k bit RAMs. The board can take 256k RAM.

There is only 4k ROM on board and a number of unidentified proprietory chips. An empty socket is intended for the clock chip, and an empty space for the clock battery. The board is well designed with only one wire jump and has a number of undocumented plugs that may provide access to features of the system.

All interface connectors are on the back end of the motherboard. The expansion sockets are accessed through the top of the computer. Video signals available on the board are PAL B&W, PAL composite video and true RGB video. A variety of text and graphic display modes are available. The standard text display is 80x24 characters, with options for 40x24 black and white and 40x24 with 16 foreground and background colours.

Graphics modes are 280x192 and 560x192 in B & W. Color modes are 280x192 with 16 colours and a composite 140x192. Colour is displayed as a grey scale on a B & W monitor.

The board has several memory management switches to support a 64k RAM space with the 6502 processor. The boot ROM is mapped into $F000-$FFFF and is switched out of memory space after system boot. The memory mapped I/O space at $C000-$CFFF can also be switched out of address space and replaced with RAM and system supports multiple stacks. The Environment register at $FDFF, used to reflect the state of the system, is a good example of the type of hardware environments that can be established.

ENVIRONMENT REGISTER

BIT	USE	CLEAR	SET
7	Clock Speed	2 Mhz	1 Mhz
6	$C000 switch	RAM	ROM
5	Video output	Off	On
4	RESET key	disable	enable
3	Protect $C000	On	Off
2	Stack	reloc	$100
1	$F000 switch	ROM A	ROM B
0	$F000	RAM	ROM

The hardware is an innovative design to provide an environment that will support more than 64k of memory and integrate standard peripheral devices into the motherboard.

The Apple III was designed to provide a standard set of peripheral devices on the motherboard and to support a hard disk. Apple began to develop a hard disk system for the Apple III in 1980, based on a Seagate 5Mb drive, and the PROFILE hard disk system has just been released.

The disk is enclosed in a small moulded plastic case (15" x 8" x 4") in regulation Apple colours. Installation of the disk requires that a driver PROFILE be configured into the system and the interface card plugged into the Apple III expansion slot so that the disk is then fully supported by the SOS. A good feature is the quietness of the drive, even during extensive disk searching.

There is a parallel card for the Apple III and other cards are being developed. Overall, the expansion bus is very similar to the Apple II bus: small interface cards that do not use a lot of the bus will work in the Apple III system. Microsoft is developing a Z-80 Softcard. The Keyboard Company has developed a joystick and M&R Enterprises have released a RGB video interface box.

SOFTWARE

The system software for the Apple III consists of 4k boot ROM and the SOS operating system.

The motherboard ROM contains the system boot code and a series of diagnostic tests that are performed after every boot. The diagnostics test RAM, ROM, I/O ports and the memory management hardware. The ROM also contains an undocumented monitor with similar functions to the Apple II

monitor. Memory can be moved, verified, displayed and searched. The monitor can also Read and Write disk blocks.

SOS provides a complete environment for all software on the Apple III. The system has combined the Apple DOS user command interface with the structure of the UCSD operating system and UNIX style hierarchical directories. A uniform interface to the system is provided for all language implemented on the Apple III.

SOS provides extensive high and low level calls to the system.

It consists of KERNEL, which has the low level interface to the system hardware, a DRIVER file that contains the interfaces that all peripheral devices configured into the system, and a P-code interpreter.

SOS has five component interfaces. The first is the file management interface. All devices in the system can be treated as clock or character structured files. A hierarchical directory structure is used where each device has a root directory that may contain both files and other directories. The location of a file is specified by the pathname of the file. The root directory must be specified followed by the other directories until the directory that contains the file is reached. A file called DEMO.CODE that is in a directory called MYDISK on the Profile hard disk would be accessed by the pathname:– PROFILE/MYDISK/DEMO.CODE. This feature is one of the hardest for Apple II users to get used to, but provides a powerful facility for the management of files on large storage devices.

A drawback is that SOS, in its provision of a universal interface for all languages, has a proliferation of filetypes. It supports 13 filetypes, from SYSTEM to UNKNWN.

The second interface is the device management interface that provides access to the drivers. The drivers accept control codes for the operation of the device or to report on status enquiries. The CONSOLE driver controls cursor position, screen window size and text colour. The 128 byte type ahead buffer and the software definable character sets are also controlled by the CONSOLE driver. The keyboard can also be remapped through the device control interface. The GRAPHIX driver provides control over the colour options table and the type of point plot on the screen. The RS232B interface can specify baud rate, data format, buffer size and a choice of no, XON/XOFF or ENQ/ACK communication protocols.

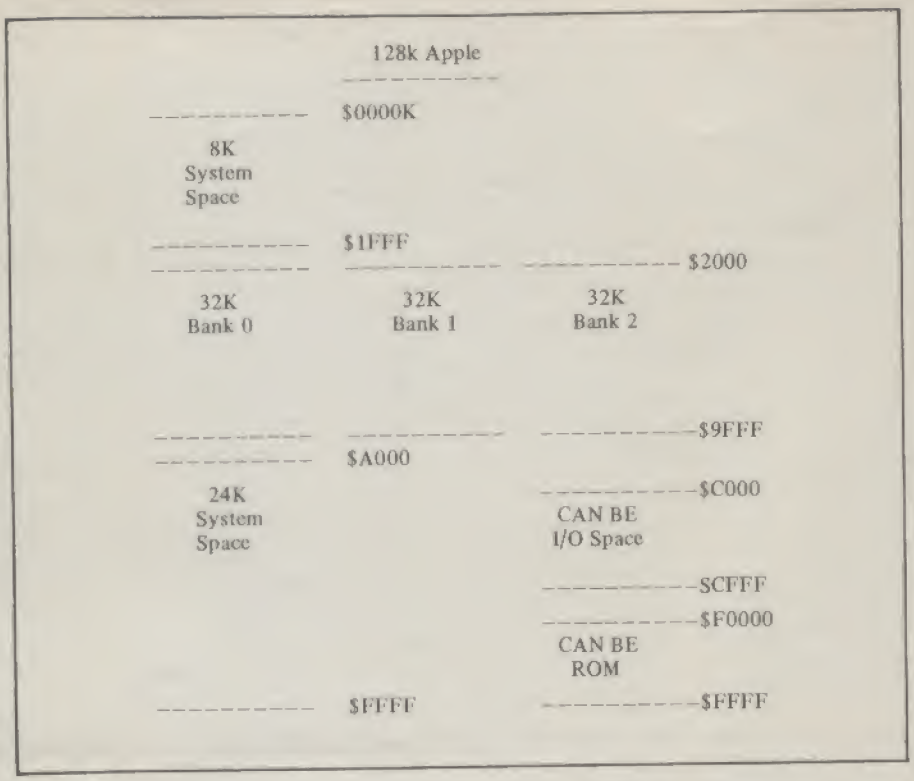
The third interface is the memory management interface that manages the allocation of memory in the system. Switches control the bank select, I/O space select and the ROM select. Memory management also controls stack relocation and the management of memory in the system.

Interrupt management is largely handled by SOS, although a user interrupt mechanism has been implemented that preserves the priority of SOS peripheral interrupts.

The utility interface provides access to the software clock and joystick ports in the system.

The SOS software includes a utilities disk that is an enhanced version of the Pascal Filer. The system support software is written in Pascal. This utility allows manipulation of disks and files, format disks and generation of a new system.

Apple III Pascal is an enhanced version of Apple UCSD Pascal 2.1. SOS has lessened the severity of the UCSD operating environment. Several additions have been made to the system including an OTHERWISE clause for the CASE statement, Bytestream and Wordstream datatypes, conditional compilation and the implementation of the IEEE single precision floating point standard. The general parameters of the system have been enlarged to utilise the available memory space. A compiler option ($SETC APPLE:=2) will generate code that is compatible with Apple II Pascal.



TECHNICAL SPECIFICATIONS

Size	17.5" x 18.2" x 4.8" Cast aluminium base with plastic moulded cover
Weight	26lbs
Processor	6502B with extended addressing hardware
Clock Speed	2Mhz peak, 1.4Mhz average
RAM memory	128 k
ROM memory	4 k
Disk Storage	One 5.25 inch floppy disk (140k)
Keyboard	74 Keys with auto-repeat, generating the full ASCII set
Screen	Text 40 x 24 Black & White 80 x 24 Black & White 40 x 24 16 foreground and background colours All characters are software definable Graphic 280 x 192 Black & White 280 x 192 16 foreground and background colours 140 x 192 16 colours 560 x 192 Black & White
Video Output	Black & White Composite colour RGB pure video Signals Pal standard
Audio output	2 inch speaker with a 6 bit DAC
Serial I/O	RS232B port
Joystick	2 joystick interfaces
Printer	Apple silenttype interface
Expansion	4 50 pin expansion slots

PROFILE HARD DISK

Disk	Seagate drive – 5M formatted data
Surfaces	4
Heads	4
Tracks/Surf	153
Sectors/Trk	16
Bytes/Sector	532
Rotation	3600 RPM
Seek time	95 msec
Data trans	5 Megabits/sec

Essentially, the Basic has been written to the Microsoft V5.0 standard with several extensions. The language has adopted the Microsoft format for Disk instruction (OPEN #1 AS OUTOUT). The most interesting feature of the language is the implementation of LONG INTEGERS with 19 digits for financial programming, a powerful PRINT USING statement, indented program listings to highlight structures, and ON KBD and ON EOF# statements.

There are no PEEK, POKE and CALL commands. The interface between Basic and machine code is contained in the INVOKE and PERFORM commands. INVOKE will load a machine code file into memory. SOS handles all memory management details and decides where to put the file. PERFORM will call the routine passing a parameter list via the stack. PEEK and POKE have no place in an environment where the system is capable of managing the environment and where there is enough control with system calls to interrogate the system. If PEEK and POKE functions are required then a machine code routine can be written to provide the information.

A separate graphics module provides commands to Draw images, points and lines and to Fill screen area and control colour selection.

Business Basic should have been available for the Apple II years ago, and will make Apple II programmers realise the inadequacy of the Applesoft Basic implementation for serious programming.

Apple has released an enhanced version of VISICALC for the III and has a word processor called Word Painter almost ready for release. Several Special Delivery Software packages have been released, including Apple Writer. There are at least six other word processing programs available for the Apple III.

Enhanced versions of Desktop Plan and PFS are also available. The PFS dealer disk includes an impressive demo for the Profile that contains all of the Skarbeks current software directory.

Paul Lutus has also produced versions of his assembler, ALD III and Forth, TransForth III for the machine.

The manuals are a delight to use, explaining the operation of the system in clear and patient style. The documentation assumes that the user is reasonably computer literate and there is little tutorial material. The specification of Business Basic and Pascal is excellent, but I get the impression that Apple has omitted a lot of technical information in an attempt to dissuade people from tampering with SOS.

The manuals have been written from the programmers point of view and provide all the information necessary to use the system.

APPLE II EMULATION

The Apple II emulation mode converts the Apple III into an Apple II. The clock speed reverts to 1 Mhz and memory is configured to a 48k Apple. The emulation disk can provide Integer or Applesoft in ROM and the Apple III serial port can be configured to emulate an Apple high speed serial card or a communications card. The configuration cannot be changed without a reboot of the emulation disk.

A wide variety of Apple II programs were tested under emulation mode including several games which are known to exploit features of the Apple II. All programs executed without any problems. Problems could occur with the game socket because the Apple III emulates the paddles using joystick ports. If a program does not use a standard paddle driver then the Apple III joystick may not respond correctly.

Not all of the features of the Apple III keyboard can be used in emulation mode as the keyboard is remapped and some keys do not generate ASCII codes that correspond to that key.

CONCLUSION

The power of the system is not in the hardware but in the complete machine environment .

The major achievement of the system is compatability with Apple II while building a software system that provides independence from the hardware design of future Apple computer systems.

The machine will be a delight for programmers, perhaps a little daunting to the home hacker and a powerful work station for users who require a computer system to assist with their work. Anyone with an information management application that requires a small hard disk should consider the Apple III.

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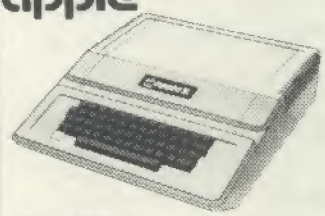

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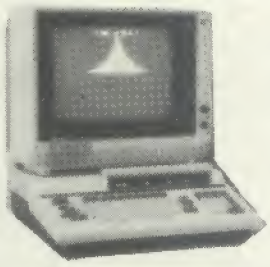

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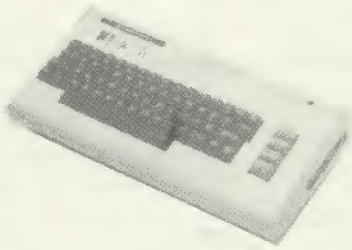

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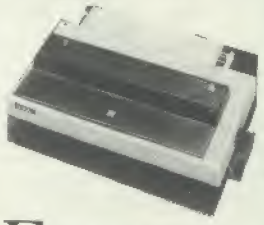

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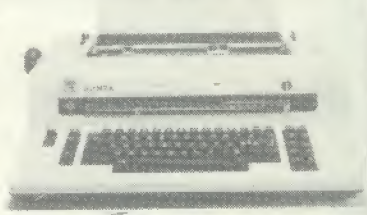

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WORD	DEC ADDR	(HEX)
HOLD	62	3E
HOT	63	3F
IN	64	40
INCORRECT	65	41
INTRUDER	66	42
KEY	67	43
LEVEL	68	44
LIGHT	69	45
LOAD	70	46
LOCK	71	47
LONGER	72	48
MORE	73	49
MOVE	74	4A
NEXT	75	4B
NO	76	4C
NORMAL	77	4D
NORTH	78	4E
NOT	79	4F
NOTICE	80	50
OPEN	81	51
OPERATOR	82	52
OR	83	53
PASS	84	54
PER	85	55
POWER	86	56
PRESS	87	57
PRESSURE	88	58
PROCESS	89	59
PULL	90	5A
PUSH	91	5B
PUT	92	5C
QUARTER	93	5D
RANGE	94	5E
REACHED	95	5F
RECEIVE	96	60
RECORD	97	61
REVERSE	98	62
RED	99	63

WORD	DEC ADDR	(HEX)
REPAIR	100	64
REPEAT	101	65
REPLACE	102	66
ROOM	103	67
SAFE	104	68
SECOND	105	69
SECURE	106	6A
SELECT	107	6B
SEND	108	6C
SERVICE	109	6D
SIDE	110	6E
SLOW	111	6F
SLOWER	112	70
SMOKE	113	71
SOUTH	114	72
STATION	115	73
SWITCH	116	74
SYSTEM	117	75
TEMPERATURE	118	76
TEST	119	77
"TH"	120	78
THANK	121	79
THIRD	122	7A
THIS	123	7B
TURN	124	7C
UNDER	125	7D
USE	126	7E
WAITING	127	7F
WARNING	128	80
WAS	129	81
WATER	130	82
WEST	131	83
WIND	132	84
WINDOW	133	85
YELLOW	134	86
YES	135	87
ZONE	136	88

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Now, having added the ABS function into line 30 to ensure that IV will always be positive, I am not sure that I have gained anything in efficiency. But, I think that it is more elegant, so I'll leave it!

If you try to run the program the way it is, you may have a problem: if the item that you are searching for is not on the list, you will get into an infinite loop and the only way out of the algorithm is to find the item. So, we have to check to see if IV has the value of 1. If it does we cannot cut in half any more; we cannot search any more. We need to test IV's absolute value, and I put it right after the compare, calling it line 25.

25 IF ABS(IV)=1 THEN GOTO (the search has failed)

If everything in the world were perfect, that would be the algorithm. However, since consistently rounding IV up for the reasons pointed out above, we may actually, at some times, exceed the bounds of the array, raising the error condition. There are several different ways to handle the problem; I believe the easiest is to take the value of IV away from PT and continue on from there. Since I don't know at this point if IV is negative or positive, I simply change its sign and add it to PT in line 55.

55 IF PT>TL OR PT>1
THEN IV = -IV:PT=PT + IV

(if you really don't like to have IV go negative and then to have to use ABS, you can use the original version of lines 40 and 50, and then use two statements here in place of 55.

IF PT<1 THEN PT=PT + IV
and IF PT > TL THEN PT=PT-IV)

My version of the binary sort algorithm is shown in figure 2.

```
10  PT=INT(TL/2+.5): IV=PT

20  IF L1$(PT)=SW$ THEN GOTO [found it! PT
    is the number of the item]

25  IF ABS (IV)=1 THEN GOTO [the search
    has apparently failed]

30  IV=(INT((ABS(IV))/2+.5)

40  IF L1$(PT)>SW$ THEN IV=-IV

50  PT=PT+IV

55  IF PT>TL OR PT<1 THEN IV=-IV: PT=PT+IV

60  GOTO 20
```

Figure 2

There is, unfortunately, still one more potential problem. If the number of items in the array (TL) is exactly a power of 2 (16, 32, 64, 128, etc), the search will not locate the very last item in the array. The reason is that when you cut in half, you don't cut perfectly in half. If the array has 16 elements in it, you look first at element 8: there are actually 7 elements above it in the array; but there are 8 elements below it! If the array has any number other than a power of 2, there is always one division which has to be rounded up, and that rounding up gives us room to get to the very end of the array. (Actually, it also caused the problem of going beyond the bounds of the array, which made us add line 55.) There are several ways to overcome the problem, including preventing the array ever from having an "undesirable" number of items. For me, the simplest thing to do is to check the last item in that array if the search fails. If they don't match, then the search actually has failed. But if it does succeed at this point, I do have to assign the value of TL to PT, as PT is what is carried into the main program to tell what item number was found. I do the entire thing in line 70:

70 IF SW$=L1(TL)
THEN PT=TL:GOTO [found it]

I also have to change line 25, so that the GOTO there branches to 70.

If the compare in line 70 yields a false, then the search has really failed, and you drop out of the binary search algorithm. Let's now look at the complete algorithm in figure 3, which is missing only the line numbers after the GOTO statements which will link the search to the programs you use it in.

```
10  PT=INT (TL/2+.5): IV=PT

20  IF L1$(PT)=SW$ THEN GOTO [found it]

25  IF ABS (IV)=1 THEN GOTO 70

30  IV=INT ((ABS(IV))/2+.5)

40  IF L1$(PT)>SW$ THEN IV=-IV

50  PT=PT+IV

55  IF PT TL OR PT 1 THEN IV=-IV: PT=PT+IV

60  GOTO 20

70  IF  SW$=L1$(TL)  THEN  PT=TL:  GOTO
    [found it]

80  REM Search has failed and you're out
    of the binary search algorithm.
```

Figure 3

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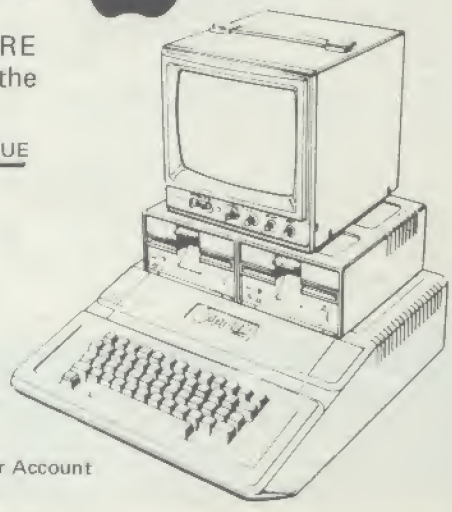

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RETURN 7F8B 02660   02470
REXIT  7E1D 00740   00550 00610 00720
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START  7FF7 03060   02220 02240
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WORDLP 7F86 02240   02630
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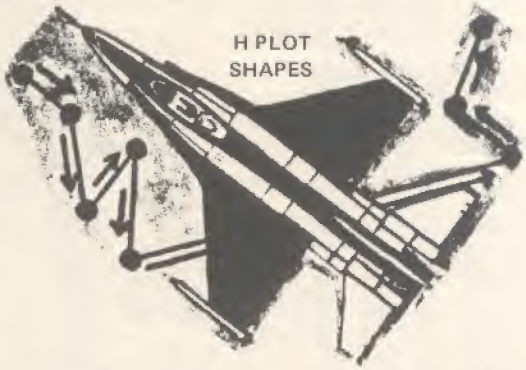

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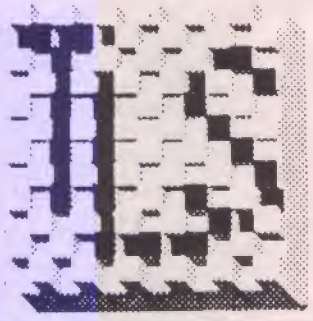

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